larly suitable for detecting atoms present in small quantities among their isotopes, so that a reasonable figure, neglecting exceptionally favourable cases, for the range of abundance between isotopes is 10^2. That between elements, even on this table, rises to 10^{14}, and if the heavier atoms were included, would be vastly greater.

It is curious to reflect how very few would be the number of types of atom known to us by physical methods of mass determination had no chemical methods of separation and concentration been available. The problem is to assign a reason for this gigantic difference of range. If the limitations of the method of detection are the only factors, then we must conclude that the number of atomic species so far discovered is only a minute fraction of those actually existing. This conclusion is interesting in itself, and has some show of probability in the case of elements of even atomic number which show great differences in isotopic complexity, but it does not seem admissible in the case of the others. Twenty-five elements of odd atomic number have been analysed so far; in ten cases two, and in no case more than two, isotopes have been detected. That this can be ascribed simply to the limit of delicacy of the method of detection seems so exceedingly improbable that it appears safer to adopt the view that the number of existing atomic species and their relative abundance shown in this diagram, though of course incomplete, are not on the whole very far wrong.

If this is so, and there are many other pieces of evidence in its support, then there appear only two possible ways of explaining the difference of range under discussion; either our sample of matter is entirely unrepresentative or the similarity between isotopic atoms must be even deeper than has hitherto been supposed. The first alternative would require that natural chemical separation and concentration had taken place to an enormous extent before the earth, or that part of it we are considering, was formed. The relative abundance of the elements in meteorites, which is not very different from that in terrestrial matter, is all against such an idea. The other and more probable alternative is one of fundamental importance and interest. The close abundance-relation between the members of groups of isotopes is most striking, and particularly is it significant in the pairs of odd atomic number, to which may be added those of antimony and silver, not on this diagram. It cannot be due to the mere identity of net nuclear charge, but must be connected in some other way with the structure of the nucleus and its stability in evolution.

It has been suggested that all atoms of the same element may in general contain an "inner nucleus" in common, and that the stability of the inner nucleus will determine the abundance of the element. Further, that this inner part being formed, outer parts may be added to the nucleus in different ways giving rise to isotopes without altering the stability to a large degree. Experimental evidence in support of this idea is already available. The mass relation between the isotopes of tin is apparently integral to the highest accuracy. The same is true of the isotopes of xenon. But the masses of the principal isotopes of tin are not integrally related to the masses of those of xenon, those of tin being the lighter by a quantity which, under the particular conditions of comparison, cannot possibly be ascribed to error of measurement. This is exactly the state of affairs to be expected if the inner nucleus common to the isotopes of tin is lighter than the inner nucleus common to those of xenon. Much more accurate mass determinations will be required to substantiate this theory, which is admittedly speculative, but it seems to supply the only feasible explanation of the facts.

Obituary.

CAPT. T. H. TIZARD, F.R.S.

CAPT. THOMAS HENRY TIZARD, formerly Assistant Hydrographer of the Navy, died on February 17 in his eighty-fifth year. He was the senior surviving officer of the old navigating branch, and came from an old seafaring family. Born at Weymouth on March 13, 1839, son of Mr. Joseph Tizard, his grandfather commanded an armed merchant vessel at the battle of Copenhagen. Educated at Royal Hospital School, Greenwich, he joined the Navy as master's assistant just seventy years ago, and served in H.M.S. *Dragon* with the Baltic Fleet during the Russian war of 1854–1856, being present at the attack on Fort Gustasvard and also at the bombardment of Sveaborg. After the Russian war, Tizard was appointed to H.M.S. *Indus* on the West Indian station, bearing the flag of Rear-Admiral Sir Houston Stewart, his former captain in the *Dragon*. Promoted to second master in February 1860, he returned to England shortly afterwards. Following the inclination of a mathematical and scientific turn of mind, the surveying service had attractions for him, and he was appointed to H.M. surveying vessel *Rifleman* on the China station. He served in that ship for seven years, during which time he laid the foundation of his subsequent reputation as an accomplished surveyor. The *Rifleman* was largely engaged on the survey of the reefs and shoals abounding in the South China Sea between Singapore and Manilla, and for some three years Tizard had command of the schooner *Saracen*, acting as tender to the *Rifleman*. He was promoted to the rank of master in June 1864, and returned home three years later suffering severely from dysentery.

In 1868–71 Tizard was serving as navigating lieutenant of H.M. surveying vessel *Newport*, commanded by Capt. (later Sir George) Nares on the Mediterranean station, and in September-October 1868 directed the laying of a submarine cable between Malta and Alexandria. The *Newport* was present at the official opening of the Suez Canal in 1869, leading the long procession of ships. During the next three years Tizard was engaged in carrying out a much-needed survey of the Gulf of Suez for the benefit of the vast volume of shipping about to use the new canal route through the Red Sea, a larger vessel, the *Shearwater*, replacing the *Newport*. Whilst serving in the *Shearwater* Tizard conferred a great boon on his brother surveyors by bringing out a "Table of Chords," thereby saving a vast amount of time and arithmetical labour

in the chart-room when plotting. During this time, also, interesting and important observations were made of the surface and under-currents in the Straits of Gibraltar, which set at rest the vexed question of movement of those waters. In all this work Tizard's strong personality and resourcefulness, combined with his intimate knowledge of both the scientific and practical sides of hydrographical surveying, exercised an influence unusual in the case of a subordinate officer.

In 1872 the appointment of Capt. Nares to command the memorable *Challenger* Expedition led to Tizard's transference to the *Challenger* as navigating officer. This afforded him the great opportunity of becoming closely associated with the science of oceanography, then comparatively in its infancy. The benefit to science in many branches resulting from the observations made during the voyage of the *Challenger* from 1872 to 1876 was a grand achievement, and one in which Tizard bore an important and leading part. Promoted to the rank of staff-commander in July 1874, he remained in the *Challenger* until her paying off in 1876, when he was appointed to the *President* for service in the Hydrographic Department of the Admiralty, being employed on the narrative of the voyage and its oceanographical results, together with a contribution to the meteorology of Japan. Little at that time was known about the latter, but from the meteorological records kept for a number of years at each of the lighthouses and lightships a very valuable series of observations had been collected. These observations were tabulated by Tizard, and from the mean monthly results diagrams were constructed showing the yearly curves.

In 1879 Staff-Commander Tizard again resumed active surveying duties afloat, serving in the *Porcupine* on the survey of the coast of England before taking charge of the survey himself the following year. From 1880–82 he was in command of the hired vessel *Knight Errant*, and in the latter year commissioned a new vessel, H.M.S. *Triton*, for surveying work on the east coast of England. During the nine years that he held this command he wrote many papers of scientific value and interest, most of which were published by the Admiralty. One of the earliest of these, on deep-sea explorations in Faeroe Channel in 1882, was read at the Royal Society and the Royal Society of Edinburgh, and in it Tizard showed that his observations established the existence of a continuous ridge across the Faeroe Channel, which was named "Wyville-Thomson Ridge." This ridge separates the cold from the warm area, and had been predicted from the *Challenger's* report so far back as 1876. Tizard thoroughly investigated it by means of cross-sections, at each end of which serial temperatures were observed and diagrams constructed showing the distribution of the temperature from the surface to the bottom, the form of the ridge, etc., besides obtaining a series of dredgings and trawlings on top of and on each side of the ridge.

The fact was also established that there is a regular interchange of the water across the Wyville-Thomson ridge, the Atlantic water flowing north-east into the Arctic basin on the surface and so far down as the ridge permits; whilst over the deepest part of the ridge there is a small outflow of Arctic water into the Atlantic, which, though of infinitely less volume than the water moving north-east, yet appears to be sufficient to enable the bottom water of the Arctic basin, immediately adjacent to the ridge, to retain its coldness.

In 1886 Tizard delivered a lecture at the School of Military Engineering, Chatham, on marine surveying, which was printed in the Professional Papers of the Corps of Royal Engineers.

The report on Tizard's survey of the outer part of the Thames estuary carried out in 1889 contains information on the tidal datums used at various places on the east coast of England and Scotland during the period covered by his survey. Two years later he compiled and published "Notes on the Tidal Datums and Levels on the River Thames and Estuary," thus bringing together in a convenient form for reference full information on tidal datums over a large part of British coasts. In 1890 Tizard published in NATURE an interesting and highly important article on "The Thames Estuary," in which he gave an account of the changes in the channels of the estuary from the commencement of the nineteenth century. He shows these changes to be of two kinds, namely, permanent changes and periodic changes, and illustrates them by a series of diagrams. The formation of the banks of the estuary and the influences operative on them are also dealt with, and the interesting phenomenon of the opening up and disappearance of swatchways, with special reference to Duke of Edinburgh Channel, is discussed. The article deals very fully with questions affecting the estuary of the Thames, and is one of great permanent value to all those whose duty it is to maintain the channels in the estuary of a river of such national importance as the Thames.

In 1891 Staff-Commander Tizard was selected for the position of Assistant Hydrographer of the Navy, and in the same year was elected fellow of the Royal Society in recognition of his contributions to oceanographical knowledge. He served on the Council of the Royal Society from 1902 to 1904.

Tizard attained the rank of staff-captain in February 1889, and was placed on the retired list with the rank of captain in December 1896. In June 1899 he was awarded the honour of a civil C.B. In 1900 he compiled an interesting chronological list of the officers conducting British maritime discoveries and surveys, together with the names of the vessels employed, from the earliest times until 1900.

The question of the feasibility of making an alternative harbour on the eastern side of the Rock of Gibraltar having been raised in the House of Commons, Capt. Tizard was charged to report on the matter, in conjunction with Mr. Shield of the Works Department of the Admiralty, and in April 1902 proceeded to Gibraltar for that purpose. The report was rendered to the Board of Admiralty in June. Capt. Tizard continued to serve at the Admiralty as Assistant Hydrographer until the autumn of 1907, when he was awarded a special pension in recognition of his valuable public services.

After his retirement he continued for some time to write and edit various Admiralty publications, among which "Tides and Tidal Streams of the British Isles" was perhaps the most important; this work he rewrote entirely.

The last, and not the least, public service performed by Tizard was to report and prepare plans to assist the Admiralty Committee, under the chairmanship of Admiral Sir Cyprian Bridge, in 1912, to arrive at a conclusion relative to the tactics employed by Nelson at Trafalgar. The investigation and co-ordination of all records from ships' logs and other sources enabled Tizard to prepare a track chart and three plans, which the Committee in its report states to be "the first and only plans representing any phase of the Battle of Trafalgar which have been exactly drawn to scale, and in which the positions assigned to particular ships in the British Fleet have been settled in accordance with the evidence contained in the logs and journals." A. M. F.

Sir Malcolm Morris, K.C.V.O.

THE sudden death on February 19 of Sir Malcolm Morris, at the age of seventy-four, removes one who for half a century has been identified with the progress of medical science in its widest aspects. His student days were passed at St. Mary's Hospital, and after qualifying and holding a house surgeoncy there, he entered upon general practice in Yorkshire for a brief period. He then proceeded to Berlin and Vienna in order to continue his medical studies, and became interested in dermatology.

After his return to Great Britain, Sir Malcolm Morris was soon appointed clinical assistant to the Blackfriars Skin Hospital, and, later, lecturer on dermatology and surgeon in charge of the skin department, St. Mary's Hospital, where he worked for twenty years. Afterwards, he was for some years dermatologist to the London School of Clinical Medicine, Greenwich. He was one of the first in Great Britain to employ the Finsen light in the treatment of skin affections, and was one of the promoters of the Radium Institute and served on its committee.

Sir Malcolm Morris naturally had his attention directed to those two scourges of mankind, tuberculosis and syphilis. He was one of the first to recognise the importance of Koch's discovery of the tubercle bacillus and, later, of tuberculin, and was Secretary-General of the British Congress of Tuberculosis held in London in 1901 when Koch made his noteworthy pronouncement on the duality of human and bovine tuberculosis. He was also a member of the International Council on Leprosy. As regards syphilis, he recognised the public apathy and conspiracy of silence respecting this disease, and became a strenuous advocate for the appointment of a Royal Commission on Venereal Diseases. He saw his proposal realised in 1913 and served as one of the Commissioners, as well as becoming a vice-president of the National Society for Combating Venereal Diseases, established in 1914.

Other public health questions also interested Sir Malcolm Morris. He was elected president of the Institute of Hygiene in 1917, was a fellow of the Royal Sanitary Institute, and long served on the Council of the Cremation Society of Great Britain. He was created K.C.V.O. in 1908. His published work included a manual of "Diseases of the Skin," which passed through several editions, and "The Story of English Public Health," and he was for a time editor of the *Practitioner* and a director of Cassells Ltd. He was a man of unbounded energy, a facile speaker, and with keen business acumen, an excellent member of committees. R. T. HEWLETT.

Rev. C. J. Ball.

THE death occurred recently of the Rev. Charles James Ball, Rector of Bletchington, Oxford, at the age of seventy-three years. Although his work was known only to a comparatively limited circle, his knowledge of Biblical Hebrew and of the text of the Old Testament was unsurpassed, and he was one of the recognised authorities in Assyriology. His earlier years were spent as classical and Hebrew master at Merchant Taylors School, and after he had been presented to the living of Bletchington in 1899, he was for a time reader of Assyriology in the University of Oxford.

Of Mr. Ball's many contributions to Biblical and Assyriological studies, the most noteworthy was a series entitled "The New Accadian," which appeared in the proceedings of the Society of Biblical Assyriology, the Council of which he joined in 1878. He here endeavoured to show that the Chinese language and writing were derived from the Proto-Babylonian or Sumerian. This series was afterwards expanded into book form and published under the title "Sumerian and Chinese," issued in 1913. Its reception was of a mixed character, partly owing to the fact that Ball's intimate knowledge of the two languages was not equally shared by any other scholar: partly to the fact that his theories were in advance of his time. They are, in fact, still *sub judice*. Equally original was his attempt to trace Semitic triliteral roots to a Sumerian origin, published in the form of contributions to the "Hilprecht Anniversary Volume" and the Proceedings of the British Academy. Although his theory is still not finally accepted, the work of other scholars on lines laid down by Mr. Ball tends to confirm it. In addition he wrote extensively on matters connected with the Old Testament, his work of most lasting value to scholars being "The Hebrew Text of Genesis with Critical Notes" and "The Book of Job, a Revised Text and Version."

THE death is announced of Mrs. Robert Gray, of Edinburgh, who had for many years collected fossils from the Ordovician and Silurian rocks of Girvan, Ayrshire, with great assiduity and skill, and had continued her field labours up to last summer. She was in her ninety-third year. Her collection of more than 40,000 specimens was recently purchased by the Trustees of the British Museum, and contains material described by T. Davidson, Alleyne Nicholson, R. Etheridge fil., Lapworth, Cowper Reed, Bather, W. K. Spencer, and other specialists. In 1903 Mrs. Gray was awarded the Murchison fund of the Geological Society of London.

WE regret to announce the following deaths:

Dr. L. Péringuey, Director of the South African Museum, Cape Town, on February 20.

Prof. H. A. Thomson, professor of surgery in the University of Edinburgh, on March 5, aged fifty-nine.